

## EXPERT SYSTEM APPLICATION TO DIAGNOSE ESCHERICHIA COLI (E-COLI) BACTERIA IN REFILLED DRINKING WATER USING THE CERTAINTY FACTOR METHOD

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### Abstract

#### Article Info

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Sometimes many people do not know whether the water is suitable for consumption or not. The reason is because the water that is consumed daily without going through the cooking or boiling process first. Many of the depots that have sprung up today do not include a letter from the local health office stating that the drinking water sold is fit for consumption. Expensive costs and very difficult affairs make the owners of drinking water depots ignore the most important things that actually must be owned. One of the things that can threaten health through drinking water is the presence of Escherichia Coli (E-Coli) bacteria. To find out whether the drinking water that is consumed contains E-Coli bacteria is not easy, because its size is very small and invisible to the eye. One of the consequences that can be caused by E-Coli bacteria is abdominal pain, vomiting, diarrhea, high blood pressure, and even kidney disorders. Certainty Factor (certainty factor) expresses belief in an event or fact based on evidence or expert judgment. Certainty Factor uses a value to assume the degree of confidence of an expert on a data. Many studies get references to do further research with different problems. Where the certainty factor method solves a problem with the concept of belief and disbelief. So that it can be seen whether the certainty factor method can also be used in solving other problems. Where the certainty factor method solves a problem with the concept of belief and disbelief. So that it can be seen whether the certainty factor method can also be used in solving other problems. Where the certainty factor method solves a problem with the concept of belief and disbelief. So that it can be seen whether the certainty factor method can also be used in solving other problems.

**Keywords:** Drinking Water, E-Coli, Expert System, Certainty Factor

### 1. Introduction

Along with the increasing demand for drinking water at this time, many depots or places for refilling drinking water have sprung up. Sometimes many people do not know whether the water is suitable for consumption or not. The reason is because the water that is consumed daily without going through the

cooking or boiling process first. Maybe the drinking water that is bought and consumed looks clean and clear like drinking water in general, but behind the clean and clear drinking water people cannot know what is contained in it. Cheap and affordable prices may be one of the reasons people choose refilled water from existing drinking water depots[1][2]. It doesn't matter where the drinking water comes from, the most important thing is that your daily drinking needs are met.

Many depots that have sprung up at this time do not include a letter from the local health office stating that the drinking water sold is fit for consumption. Expensive costs and very difficult affairs make the owners of drinking water depots ignore the most important things that actually must be owned. One of the things that can threaten health through drinking water is the presence of *Escherichia Coli* (E-Coli) bacteria. To find out whether the drinking water that is consumed contains E-Coli bacteria is not easy, because its size is very small and invisible to the eye. One of the consequences that can be caused by E-Coli bacteria is abdominal pain, vomiting, diarrhea, high blood pressure, and even kidney disorders.

In this study using Certainty Factor as a method and implementing it into an expert system. Certainty Factor (certainty factor) expresses belief in an event or fact based on evidence or expert judgment. Certainty Factor uses a value to assume the degree of confidence of an expert on a data. Based on research that has been done previously entitled "Design of Expert System Applications to Identify Diseases in Watermelon Plants Using the Certainty Factor Method"[3][4] the authors get a lot of references to do further research with different problems. Where the certainty factor method solves a problem with the concept of belief and disbelief. So that it can be seen whether the certainty factor method can also be used in solving other problems[5][6].

## 2. Literature Review

### 2.1 Artificial intelligence

Artificial Intelligence (AI) is a branch of computer science that is concerned with automating intelligent behavior. This statement can also be used as a reference from Artificial Intelligence[7]. This definition shows that Artificial Intelligence is part of computers so it must be based on sound theoretical (sound theory) and these principles include the data structures used in the representation of knowledge, the algorithms needed to apply this knowledge, as well as the programming languages and techniques used in the representation of knowledge. implement it[8].

An expert system is a computer-based application that is used to solve problems as thought by experts. The experts referred to here are people who have special skills who can solve problems that cannot be solved by ordinary people[9][10]

### 2.2 Certainty Factor

The certainty factor was introduced by Shortliffe Buchanaan in making MYCIN (Wesley, 1984). Certainty Factor (CF) is a clinical parameter value given by MYCIN to show the amount of confidence[11]. Certainty Factor is defined as follows[10]:

$$CF(H,E) = MB(H,E) - MD(H,E) \quad (1)$$

Information :

CF (H,E) : Certainty factor of hypothesis H which is influenced by symptoms (evidence)

E. The amount of CF ranges from -1 to a value of 1 indicating absolute confidence.

MB (H,E) : The measure of the increase in belief (measure of belief) on hypothesis H which is influenced by symptoms E.

MD (H,E) : The measure of increased disbelief (measure of increased disbelief) against hypothesis H which is influenced by symptom E.

Certainty factor to determine parallel CF

$$CF(x \text{ and } y) = \min(CF(x), CF(y)) \quad (3)$$

$$CF(x \text{ or } y) = \max(CF(x), CF(y)) \quad (4)$$

$$CF(\text{Not } x) = -CF(x) \quad (5)$$

Certainty factor to determine sequential CF

$$CF(H,E)1 = CF(E,e) * CF(H,E) \quad (6)$$

Certainty factor for similar rules

$$CfcombineCF(H,E)1,2 = CF(H,E)1 + CF(H,E)2 * (1 - CF(H,E)1) \quad (7)$$

$$CfcombineCF(H,E)old3 = CF(H,E)old + CF(H,E)3 * (1 - CF(H,E)old) \dots \dots \dots (2.6)$$

### 3. Results and Discussion

Based on the results of consultations conducted with the BTKL (Environmental Health Engineering Agency) Medan city, there are several characteristics of drinking water contaminated with Escherichia Coli bacteria, including:

1. Smells like sewer or mud.
2. Feels bitter or tingling on the tongue.
3. Not clear or cloudy.
4. Slightly yellowish.
5. Color changes in 2 days.

Table 1. Questions

<i>Feature Code</i>	<i>Question</i>	<i>Answer</i>						
C1	Does refilled drinking water "Smell like sewer or mud" ?	TY	ST	KY	CY	Y	SY	
C2	Does refill drinking water "Taste bitter or stinging on the tongue"?	TY	ST	KY	CY	Y	SY	
C3	Is the refill drinking water "Not clear or cloudy"?	TY	ST	KY	CY	Y	SY	
C4	Is refill drinking water "A little yellowish"?	TY	ST	KY	CY	Y	SY	
C5	Is drinking water refill "Color changes in 2 days" ?	TY	ST	KY	CY	Y	SY	

When you want to answer a question, 6 (six) answers will be given, each of which has the following weights:

1. TY (Not Sure) : 0
2. TT (Don't Know) : 0.2
3. KY (Not Convinced) : 0.4
4. CY (Quite Sure) : 0.6
5. Y (Sure) : 0.8
6. SY (Very Confident) : 1.0

Suppose the user chooses the answer to the question from the characteristics of refilled drinking water as follows:

1. Smells like sewer or mud : very confident

2. Taste bitter or tingling on the tongue : sure
3. Not clear or cloudy : sure
4. Slightly yellowish : pretty sure
5. Color change in 2 days : not sure

The first step, to determine the CF value for each water feature is as follows:

CF (Smells like sewer or mud)

$$\begin{aligned} CF(H,E) &= MB(H,E) - MD(H,E) \\ &= 0.8 - 0.2 = 0.6 \end{aligned}$$

CF (Bitter or tingling taste on the tongue)

$$\begin{aligned} CF(H,E) &= MB(H,E) - MD(H,E) \\ &= 0.8 - 0.2 = 0.6 \end{aligned}$$

CF (not clear or cloudy)

$$\begin{aligned} CF(H,E) &= MB(H,E) - MD(H,E) \\ &= 0.8 - 0.2 = 0.6 \end{aligned}$$

CF (Slightly yellowish)

$$\begin{aligned} CF(H,E) &= MB(H,E) - MD(H,E) \\ &= 0.6 - 0.4 = 0.2 \end{aligned}$$

CF (Color change in 2 days)

$$\begin{aligned} CF(H,E) &= MB(H,E) - MD(H,E) \\ &= 0.6 - 0.4 = 0.2 \end{aligned}$$

Furthermore, based on the user's choice of answers, the initial rule or rule that has 5 (five) premises (symptoms) is broken down into rules that have a single premise, so that it becomes:

Rule 1.1

IF Smells like sewer or mud

THEN Contains Escherichia coli bacteria

1.2 . rule

IF Taste bitter or tingling on the tongue

THEN Contains Escherichia coli bacteria

Rule 1.3

IF Not clear or cloudy

THEN Contains Escherichia coli bacteria

Rule 1.4

IF Slightly yellowish

THEN Contains Escherichia coli bacteria

1.5 . rule

IF Color change in 2 days

THEN Contains Escherichia coli bacteria

The new rules or rules are then calculated the CF value by multiplying CF(user) by CF(expert) to become:

$$CF(H,E) = CF(\text{Expert}) * CF(\text{User})$$

$$CF\ 1.1 = 0.6 * 1.0 = 0.6$$

$$CF\ 1.2 = 0.6 * 0.8 = 0.48$$


$$CF\ 1.3 = 0.6 * 0.8 = 0.48$$

$$CF\ 1.4 = 0.2 * 0.6 = 0.12$$

$$CF\ 1.5 = 0.2 * 0 = 0$$

The last step is to combine the CF values of each rule, which is to combine CF 1.1 with CF 1.2 with the following formula:

CFcombine (CF1, CF2) = CF1 + CF2\*(1-CF1), so it becomes

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$$\begin{aligned} \text{CFcombine (CF1, CF2)} &= 0.6 + 0.48*(1 - 0.6) \\ &= 0.6 + 0.192 \\ &= 0.792 \text{ CFold} \end{aligned}$$

Combine CFold with CF 1.3

$$\begin{aligned} \text{CFcombine(CFold, CF3)} &= 0.792 + 0.48*(1 - 0.792) \\ &= 0.792 + 0.09984 \\ &= 0.89184 \text{ CFold2} \end{aligned}$$

Combine CFold2 with CF 1.4

$$\begin{aligned} \text{CFcombine(CFold2, CF4)} &= 0.89184 + 0.12*(1 - 0.89184) \\ &= 0.89184 + 0.0129792 \\ &= 0.9048192 \text{ CFold3} \end{aligned}$$

Combine CFold3 with CF 1.5

$$\begin{aligned} \text{CFcombine(CFold3, CF5)} &= 0.9048192 + 0*(1 - 0.9437568) \\ &= 0.9048192 + 0 \\ &= 0.9048192 \text{ CFold4} \end{aligned}$$

From the calculation results above, the CF value is 0.9048192. then the percentage of confidence =  $\text{CFold4} * 100\% = 0.9048192 * 100\%$   
 $= 90.48192\%$

Can be rounded to = 90.48%.

Thus it can be said that the calculation of certainty factor on Escherichia coli bacteria in refill drinking water has a confidence level of 90.48% confidence level.


## Discussion

The application of the certainty factor method is very suitable for use in expert systems to diagnose Escherichia coli bacteria in refilled drinking water, so that the results of the certainty level of being diagnosed with Escherichia coli bacteria can be known, which basically users of this application do not know whether the refilled drinking water to be consumed contains Escherichia coli bacteria. or not. From the results of the tests carried out, the confidence level value is 90.48%

## 4. Conclusion

Based on the research conducted, it was found that To diagnose bacteria in refilled drinking water, that is by determining the CF value of each of the characteristics of refilled drinking water containing Escherichia coli (e-coli) bacteria and diagnosing Escherichia coli bacteria by showing the value of the level of confidence. The application of the certainty factor method is very suitable for use in expert systems to diagnose Escherichia coli bacteria in refilled drinking water, so that it can be seen the results of the certainty level of Escherichia coli diagnosis which basically users of this application do not know whether the refilled drinking water to be consumed contains Escherichia coli bacteria. or not.

## Reference

- [1] EP Gunawan and R. Wardoyo, "An Expert System Using Certainty Factor for Determining Insomnia Acupoint," *IJCCS (Indonesian J. Comput. Cybern. Syst.*, vol. 12, no. 2, p. 119, 2018, doi:10.22146/ijccs.26328.
  - [2] V. Mayora, B. Ginting, and FA Sianturi, "LABORATORY USING SIMPLE ADDITIVE WEIGHTING ( SAW ) METHOD IN GRANMED HOSPITAL," *J. Inform. Nusan lamp.*, vol. 4, no. 2, pp. 1–7, 2019, [Online]. Available: <http://e-jurnal.pelitanusantara.ac.id/index.php/JIPN/article/view/606>.
  - [3] B. Sasangka and A. Witanti, "Expert System for Diagnosing Acute Respiratory Infections in Children Using Bayes' Theorem," *JMAI (Jurnal Multimed. Artif. Intell.*, 2019,
-  INFOKUM is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License (CC BY-NC 4.0)

- doi:10.26486/jmai.v3i2.83.
- [4] JT Informatics, T. Informatics, SI Industri, T. Informatika, and PC Riau, "Expert System for Diagnosing Kidney Disease Using Methods," *Sis. Experts in Diagnosing Kidney Disease Using the Method. Hill Climbing*, 2012.
  - [5] T. Hidayat, HN Nasution, SWR Nasution, and R. Fauzi, "EXPERT SYSTEMS TO DIAGNOSE LUPUS DISEASE USING CERTAINTY FACTOR METHOD," *J. Educ. Dev.*, 2019, doi:10.37081/ed.v7i3.1201.
  - [6] B. Sinaga, PM Hasugian, and AM Manurung, "Expert System Diagnosing Smartphone Damage," vol. 3, no. 1, pp. 333–339, 2018.
  - [7] W. Purba, D. Ujung, T. Wahyuni, L. Sihaloho, and J. Damanik, "DESIGNING ONLINE TICKET BOOKING INFORMATION SYSTEMS AT KMP . IHAN BATAK BASED," vol. 3, no. 2, pp. 65–75, 2020.
  - [8] RA Ramadhani, "Expert System for Hepatitis Diagnosis Using the K-NN Method for Primary Health Services," no. November, 2017.
  - [9] AJ Aziz Amrullah and E. Ekojono, "EXPERT SYSTEM FOR DIAGNOSIS OF LUNG DISEASES LUNGS WITH FORWARD CHAINING METHOD," *J. Inform. Polinema*, 2017, doi: 10.33795/jip.v2i1.48.
  - [10] Minarni and A. Fadhillah, "Expert System in Detecting Rice Plant Diseases," *J. Dyn.*, vol. 2, no. 1, pp. 11–15, 2017, doi:10.22216/JoD.2017.V2.11-15.
  - [11] D. Kiray and FA Sianturi, "Diagnose Expert System Computer Malfunction Certainty Factor Method," *J. Comput. Networks, Archit. High Performance. Comput.*, 2020, doi:10.47709/cnape.v2i1.358.